Listing of Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

1.(currently amended) A semiconductor wafer processing system having a vacuum environment therein and comprising:

a semiconductor wafer processing module having a wafer holder therein configured to hold a semiconductor wafer for processing in the vacuum environment, the processing module also having mounting structure therein configured to removably mount a maintenance item in the vacuum environment in the processing module and to present the maintenance item for pick up therefrom or to accept the maintenance item for placement thereon by a wafer transfer mechanism;

~~the processing module having~~ a maintenance item removably mounted on the mounting structure;

a transfer system having a transfer mechanism therein operable to transfer either a semiconductor wafer by wafer handling motions within the vacuum environment between the transfer system and the processing module for processing on the wafer holder, or ~~configured~~ to transfer a maintenance item by wafer handling motions within the vacuum environment between the mounting structure in the processing module and the transfer system without exposing the processing module to an outside environment.

2.(original) The processing system as claimed in claim **1**, further comprising:

an isolation assembly coupled between the processing module and the transfer system, the isolation assembly comprising a gate valve assembly.

3.(original) The processing system as claimed in claim **1**, further comprising:

a maintenance system comprising a storage assembly storing at least one maintenance item and an exchange system for transferring a maintenance item between the transfer system and the maintenance system without exposing the vacuum environment to an outside environment.

4.(original) The processing system as claimed in claim **3**, further comprising:

an isolation assembly coupled between the maintenance system and the transfer system, the isolation assembly comprising a gate valve assembly.

5.(original) The processing system as claimed in claim **3**, wherein the exchange system comprises:

a drive system, a transfer arm coupled to the drive system, and an end effector coupled to the transfer arm, the drive system being used to move the transfer arm and the end effector in at least one direction in order to transfer the removably mounted maintenance item between the maintenance system and the processing module.

6.(original) The processing system as claimed in claim **3**, wherein the exchange system comprises:

a drive system, a transfer arm coupled to the drive system, and an end effector coupled to the transfer arm, the drive system being used to move the transfer arm and the end effector to transfer the substrate between a transfer plate in the transfer system and a substrate holder in the processing module.

7.(currently amended) The processing system as claimed in claim **3**, wherein:

the maintenance system includes a storage assembly; and

the exchange system comprises**[[;]]** a drive system, a transfer arm coupled to the drive system, and an end effector coupled to the transfer arm, the drive system being used to move the transfer arm and the end effector to transfer the removably mounted maintenance item between the transfer system and **[[**a]] the storage assembly in the maintenance system.

8.(original) The processing system as claimed in claim **1**, wherein the transfer system comprises a transfer plate and a transfer assembly for moving the transfer plate from the one position to another position.

9.(original) The processing system as claimed in claim **1**, wherein the maintenance item comprises at least one of a ring, a shield, an insulator, an adapter, a baffle, and a plate.

10.(original) The processing system as claimed in claim **1**, further comprising:

a controller coupled to the processing module and the transfer system, the controller being programmed to control the processing module and the transfer system to replace the maintenance item on the mounting structure without exposing the processing module to an outside environment.

11.(original) The processing system of claim **1** wherein:

the processing module is an etching module having an upwardly facing wafer support in a vacuum environment therein;

the maintenance item is an annular member in a mounting position in the etching module surrounding a wafer support area of the wafer support where the maintenance item is prone to being etched by an etching process being performed on a wafer in the etching module; and

the maintenance item is mounted in its mounting position in the etching module so as to be removable from the processing module in part by a lifting of the maintenance item from the mounting position.

12.(original) The processing system of claim **1** wherein:

the processing module includes a deposition module having an upwardly facing wafer support in a vacuum environment therein;

the maintenance item is an annular member in a mounting position in the deposition module surrounding a wafer support area of the wafer support where the maintenance item is prone to collecting deposits of material thereon when a deposition process is performed on a wafer on the support in the deposition module; and

the maintenance item is mounted in its mounting position in the deposition module so as to be removable from the processing module in part by a lifting of the maintenance item from the mounting position.

13.(currently amended) The processing system of claim **1** wherein:

the mounting structure is configured to move the maintenance item from a mounting position for use during processing into position for pick up by the transfer mechanism.

14.(original) The processing system of claim **13** wherein:

the maintenance item is an annular ring configured to surround a wafer on a wafer support;

the mounting structure includes a set of lift pins operable to lift the ring into position for pick up by a wafer transfer arm.

15.(original) The processing system of claim **13** wherein:

the maintenance item is supported within the processing module from the top of the processing module;

the mounting structure includes a set of elements for releaseably holding the maintenance item and operable to lower the maintenance item into position for pick up by a wafer transfer arm.

16.(original) The processing system of claim **13** wherein:

the transfer mechanism includes a wafer transfer arm and a separate transfer arm configured to pick up a maintenance item.

17.(original) The processing system as claimed in claim **1**, wherein the processing module comprises at least one of an ALD module, a deposition module, a coating module, a patterning module, a developing module, a metrology module, a thermal processing module, and a cleaning module.

18.(currently amended) A method of operating a semiconductor wafer vacuum processing system that includes a wafer processing module coupled to a wafer transfer system having an interior with a vacuum environment therein, to provide for replacement of an expendable or serviceable maintenance item of a processing module using components and wafer handling motions of a wafer transfer system without exposing the interior of the processing system to an outside environment, the method comprising:

coupling a processing module to a transfer system having a wafer transfer arm therein, the processing module having a first maintenance item removably mounted therein;

presenting the first maintenance item within the processing module for pick up by **[[**a**]]** the wafer transfer arm of the transfer system;

transferring semiconductor wafers in the vacuum environment between the transfer system and the processing module for processing in the processing module using wafer handling motions of the wafer transfer arm; and

picking up the first maintenance item with the wafer transfer arm and transferring the first maintenance item from the processing module to the transfer system using wafer handling motions of the transfer arm without exposing the interior of the processing module to an outside environment.

19.(currently amended) The method of claim **18** wherein:

the first maintenance item is an annular member in a mounting position in the processing module that surrounds a wafer support area on an upwardly facing wafer support where the first maintenance item is prone to being etched or coated by a process performed on **[[**the**]]** a wafer in the processing module; and

the first maintenance item is removable from the processing module in part by lifting the first maintenance item from the mounting position.

20.(currently amended) The method of operating a processing system as claimed in claim **18**, the method further comprising:

coupling a maintenance system to the transfer system, the maintenance system having a second maintenance item therein;

transferring the second maintenance item from the maintenance system to the transfer system;

transferring the second maintenance item using wafer handling motions of the transfer arm from the transfer system to the processing module without exposing the interior of the processing module to an outside environment; and

removably mounting the second maintenance to the processing module.

21.(original) The method of operating a processing system as claimed in claim **18**, the method further comprising:

transferring the first maintenance item to a transfer plate; and

moving the transfer plate from a first position to a second position.

22.(currently amended) The method of operating a processing system as claimed in claim **[[18]] 20**, the method further comprising:

transferring the second maintenance item to a transfer plate; and

moving the transfer plate from a second position to a first position.

23.(original) The method of operating a processing system as claimed in claim **18**, the method further comprising:

transferring the first maintenance item to a storage assembly in a maintenance system without exposing the processing module to an outside environment.

24.(original) The method of operating a processing system as claimed in claim **20**, the method further comprising:

transferring a substrate from the transfer system to the processing module without exposing the processing module to an outside environment;

processing the substrate in the processing module; and

transferring the processed substrate from the processing module to the transfer system.

25.(currently amended) The method of operating a processing system as claimed in claim **[[18]]** 27, the method further comprising:

monitoring the first maintenance item without exposing the processing module to an outside environment;

determining when to replace the first etching maintenance item; and

performing the detaching and the transferring in response to the determination.

26.(original) The method of operating a processing system as claimed in claim **18**, the method further comprising:

monitoring a processing recipe for the processing module; and

determining when to exchange the first maintenance item with a second maintenance item, wherein the process recipe specifies a different maintenance item.

27.(currently amended) The method of claim **18** further comprising:

coupling **[[**a]] the processing module having **[[**a]] the first maintenance item removably mounted therein to a first exchange system;

coupling the first exchange system to **[[**a]] the transfer system;

detaching the first maintenance item from the processing module; and

transferring the first maintenance item from the processing module to the transfer system without exposing the processing module to an outside environment.

28.(currently amended) The method of operating a processing system as claimed in claim **27**, the method further comprising:

coupling a maintenance system to a second exchange system, the maintenance system comprising a second ~~etching~~ maintenance item, wherein the second ~~etching~~ maintenance item can be removably mounted in the ~~etching~~ processing module;

coupling the second exchange system to a second position in the transfer system;

transferring the second ~~etching~~ maintenance item from the maintenance system to the transfer system, wherein the second exchange system comprises means for transferring the second maintenance item between the maintenance system and the transfer system without exposing the ~~etching~~ interior of the processing module to an outside environment;

transferring the second ~~etching~~ maintenance item from the transfer system to the processing module, wherein the first exchange system comprises means for transferring the second ~~etching~~ maintenance item between the transfer system and the processing module without exposing the ~~etching~~ interior of the processing module to an outside environment; and

removably coupling the second ~~etching~~ maintenance item to the ~~etching~~ processing module.

29.(currently amended) A method of operating a semiconductor wafer processing system comprising:

coupling a processing module having a first maintenance item removably mounted therein in a processing position that exposes the item to wear or contamination due to a process performed on a semiconductor wafer in the processing module, to an exchange system using a first isolation assembly;

coupling the exchange system to a maintenance system using a second isolation assembly;

vertically moving the maintenance item into a transfer position within the processing module for pick up of the first maintenance item from the processing module by the wafer transfer arm;

transferring the first maintenance item from the processing module to the maintenance system through the first and second isolation assemblies without exposing the processing module and the first maintenance item to an outside environment;

transferring a second maintenance item from the maintenance system to the processing module through the first and second isolation assemblies without exposing the processing module and the second maintenance item to an outside environment; and

removably mounting the second maintenance item to the processing module.

30.(new) A method of configuring a semiconductor wafer processing system that includes a transfer module having a plurality of ports configured for coupling to one or more wafer processing modules or other modules, wherein each of the modules has an interior in a vacuum environment, and wherein the transfer module has a wafer transfer mechanism therein that includes a transfer arm that is moveable through a plurality of wafer handling motions to transfer a semiconductor wafer among the ports of the transfer module and various processing or other modules coupled thereto, the method comprising:

coupling to one of the ports of the transfer module a processing module having removably mounted therein a maintenance item configured to be picked up by the transfer arm and moved therewith by one or more of the wafer handling motions through one or more of the ports and the transfer module, the process module comprising mounting structure configured to removably mount the maintenance item in the vacuum environment in the processing module and to present the maintenance item for pick up by the wafer transfer arm of the transfer mechanism;

coupling to another one of the ports of the transfer module at least one other module equipped for the servicing or exchange of the maintenance item moved thereto by the transfer arm while in the vacuum environment; and

configuring the transfer module for operation of the transfer mechanism to pick up the maintenance item from the mounting structure and move the maintenance item through the transfer module and ports thereof to the other module for exchange or servicing.

31.(new) The method of claim **30** further comprising:

mounting on an end of the transfer arm an end effector configured to pick up and hold the maintenance item for movement with the transfer arm.

32.(new) The processing system as claimed in claim **1**, wherein the transfer mechanism includes a transfer arm having an end effector configured to hold a semiconductor wafer for transfer, the end effector also being configured to hold a maintenance item for transfer.

33.(new) The processing system as claimed in claim **1**, wherein the transfer mechanism includes a first transfer arm having a first end effector thereon configured to hold a semiconductor wafer for transfer and a second transfer arm having a second end effector thereon configured to hold a maintenance item for transfer.